Modeling Driver Behavior at Roundabouts:

Impact of Roundabout Layout and Surrounding Traffic on Driving Behavior

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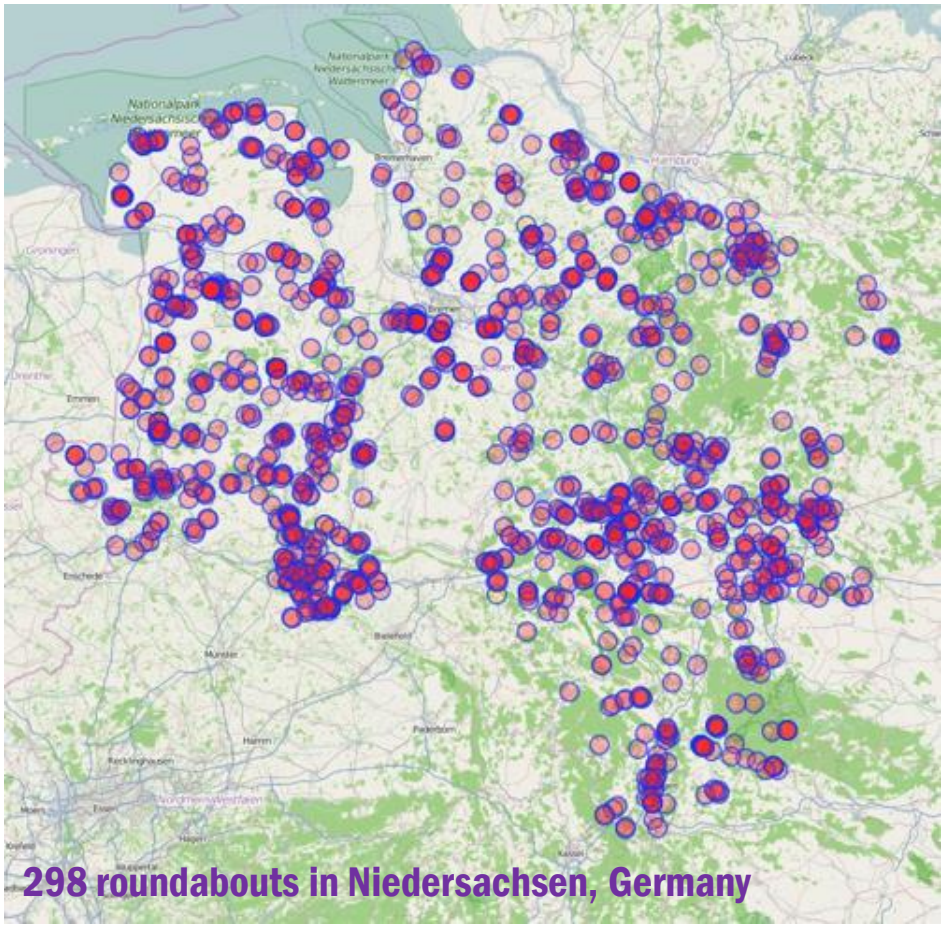
Motivation

- increasing number of roundabouts
- crashes at roundabouts



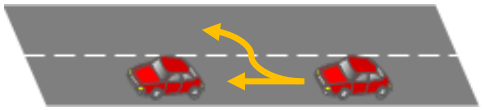
Objective

driver behavior prediction

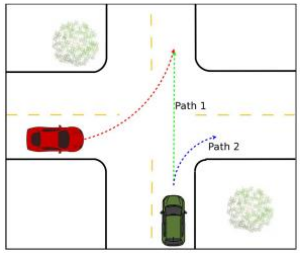
- leave roundabouts or stay

State of the art

driver behavior on motor way: lane changing / keeping



driver behavior at intersections: different driving direction



driver behavior at roundabouts:

- results of field study: status of steering wheel and Machine Learning algorithm for recognition with accuracy above 97% at c.a.11 m away from exits.

-- Zhao, et al. (2017)

Research questions

Question 1: How does **roundabout layout** impact steering wheel status?

Question 2: How does **surrounding traffic** impact driving pattern recognition?

Results

Question 1: How does **roundabout layout** impact steering wheel status?

Answer: Steering wheel angle is quantitatively related to roundabout geometric feature.

Question 2: How does **surrounding traffic** impact driving pattern recognition?

Answer: With presence of surrounding cyclists, the driving pattern recognition accuracy reaches 100% later than in the scenario without traffic, no matter which direction the cyclists come from.

Simulator study: Design

Experiment settings for question 1 (How does roundabout layout impact steering wheel status?)

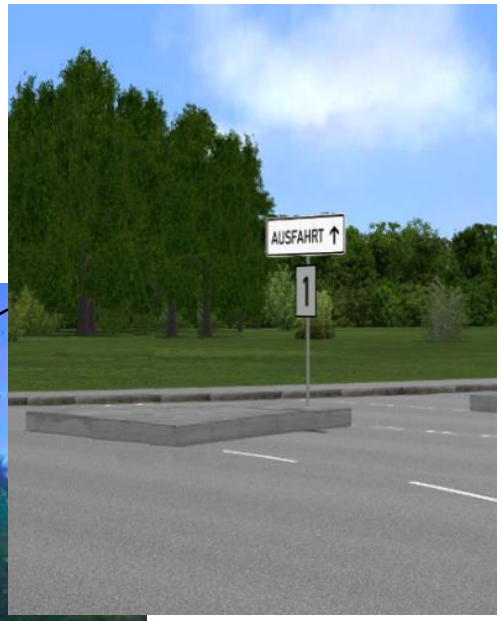
factor:

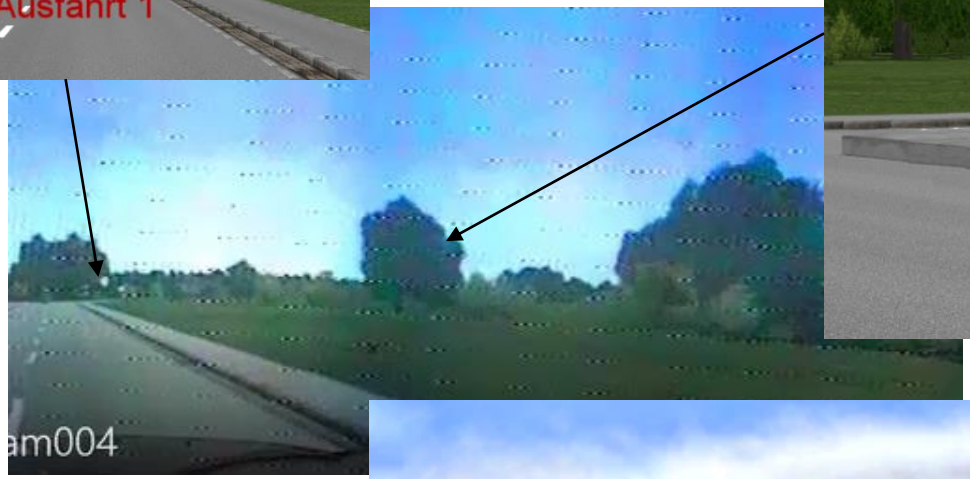
- roundabout diameter
- entry-exit-angle

Simulator study: Procedure

- thirteen participants (three females and ten males)
- simulator
- driving behavior variables
  - position,
  - velocity and acceleration,
  - steering wheel position
  - gaze direction and head direction

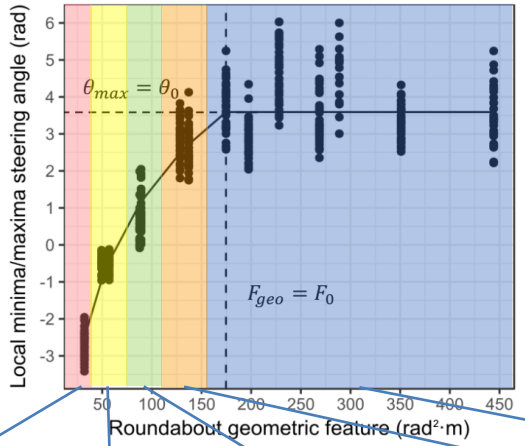
Simulator study: Procedure

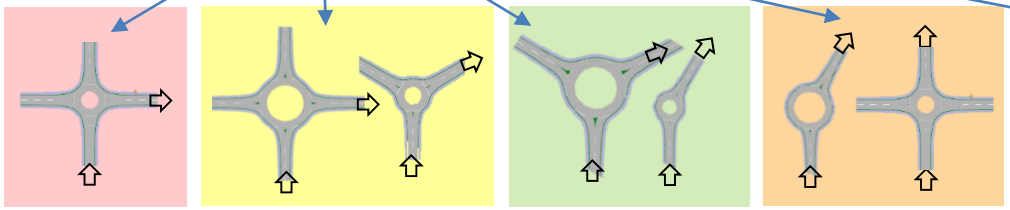


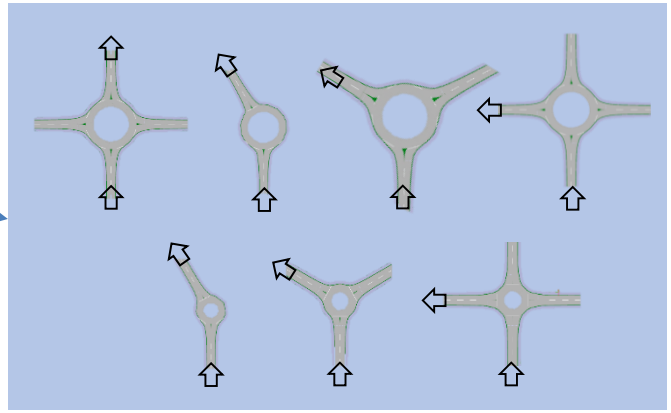


Simulator study: Results

Answer for question 1







Situation 1:

Diameter 26 m
Entry-exit-angle 90°

Situation 2:

Diameter 40 m
Entry-exit-angle 90°

Diameter 26 m
Entry-exit-angle 120°

Situation 3:

Diameter 40 m
Entry-exit-angle 120°

Diameter 26 m
Entry-exit-angle 150°

Situation 4:

Diameter 40 m
Entry-exit-angle 150°

Diameter 26 m
Entry-exit-angle 180°

Situation 5:

Diameter 40 m
Entry-exit-angle 150° - 270°

Diameter 26 m
Entry-exit-angle 180° - 270°

DLR

Simulator study: conclusion

Question 1: How does **roundabout layout** impact the driving behavior?

Steering wheel angle is logarithmically related to roundabout geometric feature. This finding can be used in behavior prediction for generic roundabouts.

Simulator study: Design

Experiment settings for question 2 (How does surrounding traffic impact driving pattern recognition?)

factor:
Four different positions of
bicycles

Simulator study: conclusion

Question 2: How does **surrounding traffic** impact driving pattern recognition?

With presence of surrounding cyclists, the driving pattern recognition accuracy reaches 100% later than in the scenario without traffic, no matter which direction the cyclists come from. The impact of cyclists from left is the smallest.

Thanks for your attention!